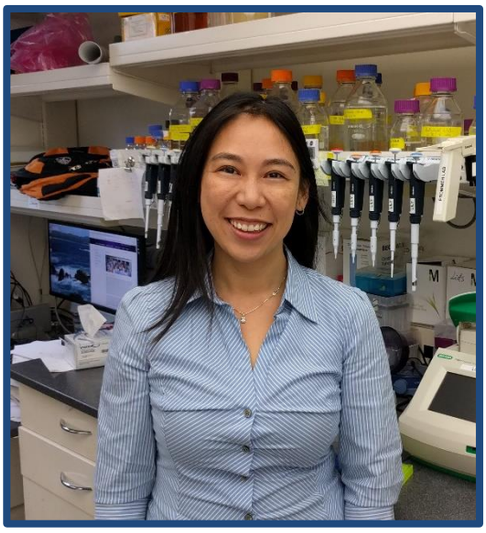
“Spying on Sugar Transporters: Kinetic Studies of Biomolecular Sensors”

Wednesday
March 2, 2022
3:30 p.m.
Wu and Chen Auditorium



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Abstract

The allocation of sugars from photosynthetic leaves to storage tissues in seeds, fruits, and tubers is an essential determinant of crop yields. In plants, transporters play critical roles in allocating carbon to different organs. Transgenic modifications of plant membrane transporters have been shown to enhance crop yield and increase plants' resistance to biotic and abiotic stresses. Yet, quantitative, systems-level models to support this effort are lacking.

Recently, biosensors gained traction for collecting spatio-temporally resolved information on cell physiology and to validate computational models. In this talk, we report the design and use of genetically encoded biosensors to measure the activity of SWEETs, the only known family of sugar transporters that facilitate the cellular release of sugar in plants. We created a SweetTrac sensor by inserting circularly-permutated GFP into a SWEET transporter, resulting in a chimera that translate substrate-triggered conformational rearrangements during the transport cycle into detectable changes in fluorescence intensity. We demonstrate that a combination of cell sorting and bioinformatics can be applied as a general approach to accelerate the design of biosensors for *in vivo* biochemistry.

Finally, mass action kinetics analysis of the sensor's response suggests that SWEETs are low-affinity, near-symmetric transporters that can rapidly equilibrate intra- and extracellular concentrations of sugars. These types of models provide new insight into the working of sugar transporters and can help realize multiscale, dynamic simulations of metabolite allocation to guide crop improvement.

Bio

Lily Cheung got her research start at Rutgers University, where she graduated Summa Cum Laude with a B.S. in Chemical Engineering in 2008. She then earned her Ph.D. in Chemical Engineering from Princeton University in 2013, where, under the supervision of Stanislav Shvartsman, she characterized gene regulatory networks using a combination of molecular biology, genetics, and reaction-diffusion modeling.

During her postdoctoral training with Wolf Frommer at the Carnegie Institution for Science, she designed biomolecular sensors to quantify sugar transport in plants. Her current interests include the use of high-throughput quantitative techniques and mathematical modeling to advance our understanding of how metabolic and gene regulatory networks interact to control plant growth.

Dr. Cheung is the recipient of an NSF NPGI Postdoctoral Fellowship in Biology, an NSF CAREER Award, and a Human Frontier Science Program Early Career Award.

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